[001] HYDRODYNAMIC TORQUE CONVERTER

[002]

[003]

[004] According to the type precisely defined in the preamble of claim 1, the invention relates to a hydrodynamic torque converter.

[005]

[006] Generic hydrodynamic torque converters comprise a housing connectable via a clutch with a pump impeller and while rotating said pump impeller conveys pressure fluid to a turbine wheel connected with one output of the hydrodynamic torque converter which preferably forms the drive mechanism of a powershift transmission. The hydraulic pressure within the converter housing changes depending on the state of operation of the hydrodynamic converter. In generic converters the housing, in order to cool the converter, is flown through with pressure fluid conveyed by a hydraulic pump. The hydraulic pump is often connected with the prime mover whereby the flow rate varies depending on the input rotational speed of the hydraulic pump. The variation of the flow rate additionally influences the hydraulic pressure in the converter housing.

[007] DE 195 21 458 A1 discloses a hydrodynamic torque converter where a prime mover can be connected via a clutch with the pump impeller.

[008] The problem on which this invention is based is to provide a hydrodynamic torque converter with one clutch within the converter housing where the clutch can be controlled with precision.

[009] The problem is solved with a hydrodynamic converter according to the preamble of the main claim and including also the characteristic features thereof.

[010]

[011] The inventive hydrodynamic torque converter comprises one housing connected with a prime mover, the housing being connectable via at least one clutch with other parts of the converter. The actuation device of the clutch has at least one piston which comprises one first piston area directly loaded with the

pressure fluid located in the interior of the housing. The converter inner pressure, which varies as result of the operating conditions of the converter and the rotational speed of the hydraulic pump, thus acts upon said first piston area. The second area of the piston of the actuation device forms one side of a space which can be loaded with pressure fluid by a supply line. If the clutch is purposefully brought to slip, then a defined piston force is needed which acts upon the clutch. Since the hydraulic pressure acting upon the first piston area steadily varies, the hydraulic pressure acting upon the second area likewise has to be steadily changed in order that the piston exerts a defined force upon the clutch. Therefore, according to the invention, the hydraulic pressure acting upon the second piston area changes according to the hydraulic pressure acting upon the first piston area. In a first embodiment, the pressure acting upon the first piston area, is directly or indirectly measured by a pressure sensor which relays this pressure signal to an electronic control unit which adjusts the pressure acting upon the second piston area according to a nominal value setting and according to the measured pressure acting upon the first piston area so that the piston exerts a defined force upon the clutch. The pressure sensor can be situated here in the direct proximity of the first piston area, but it is possible to deliver the pressure at one other place, via a connection, such as a line or hole in a shaft, the pressure fluid acting upon the first piston area having to communicate with the delivery place. It is possible to also make use of correction factors depending, for example, on rotational speed or pressure medium temperatures. Here a hole is preferably used in the non-rotatable shaft connected with the stator for transmitting the pressure.

[012] In another embodiment, there exists a connection to the pressure medium acting upon the first piston area to a valve unit whose pressure medium supply is the pressure medium acting upon the first piston area and which according to a nominal value setting guides this pressure medium to the second piston area. The same pressure thus acts upon the first and the second piston areas when the valve unit is fully open whereby the clutch is in opening direction and transmits no torque. By reducing the pressure upon the second piston area, the pressure of the

first piston area prevails and the clutch is actuated in closing direction. Depending on the variation of the pressure acting upon the first piston area and the nominal value setting, the pressure acting upon the second piston area is adjusted by the valve unit. In one other embodiment, a connection exists between the pressure medium acting upon the first piston area and a valve unit, said pressure medium and thus the pressure assuming a pure control function of the valve unit. The second piston area is supplied with pressure medium by a source which can be, for example, a hydraulic pump, in addition, which assumes the through flow of the hydrodynamic torque converter or a lubrication pump of a powershift transmission. The valve unit guides pressure medium from said hydraulic pump according to the pressure acting upon the first piston area and the nominal value setting in the space formed with the second piston area. In another embodiment, the valve units described can be combined with the electronic control unit and, in addition, t is possible to issue the output signal of the electronic control unit to a proportional valve which then adjusts the clutch pressure acting upon the second piston area. In another embodiment, it is possible in the electronic control unit to process together correction factors like, for example, the rotational speed of the prime mover, the rotational speed of the pump impeller, the rotational speed of the turbine impeller, one characteristic of the hydrodynamic converter, the rotational speed on one output or measured torque on parts of the hydrodynamic converter or on parts of the transmission.

[013] By the inventive solution, it is thus possible to control a clutch exactly within a hydrodynamic torque converter and purposefully keep it in a defined slip state.

[014]

[015] Other features are to be understood from the description of the figures which show:

[016] Fig. 1 is a diagram of a hydrodynamic torque converter with one valve unit having its pressure medium supply connected with the pressure medium acting upon the first piston area;

[017] Fig. 2 is a hydrodynamic torque converter with a valve unit having its pressure medium supply connected with a hydraulic pump;

[018] Fig. 3 is a hydrodynamic torque converter with an electronic control unit which processes signals from a pressure sensor;

[019] Fig. 4 is a sectional drawing of a hydrodynamic torque converter with a converter bridge clutch; and

[020] Fig. 5 is a sectional drawing of a hydrodynamic torque converter with a converter ridge clutch and a primary clutch.

[021]

[022] Fig. 1:

A prime mover (not shown) drives a converter housing 1 connected with a primary clutch 2. One piston 3 has a first piston area 4 and a second piston area 5. If the hydraulic pressure prevails upon the piston area 4, the clutch 2 is actuated in closing direction and connects the converter housing 1 with a pump impeller 6 of the hydrodynamic converter. By rotation of the pump impeller 6 pressure medium within the converter housing 1 is conveyed to a turbine impeller 7 which thereby produces a torque. In order to cool the parts within the converter housing 1, the pressure medium flows steadily via a pressure medium supply line 8 through the hydrodynamic converter. This pressure medium is preferably conveyed by a hydraulic pump that communicates with the prime mover. By changing the rotational speed of the prime mover, the pressure within the housing 1 changes and thus the pressure upon the first piston area 4. A space 10 is connected with a valve unit 11 via a line 9. If the valve unit 11 is now adjusted by a nominal value setting 12 which can be, for example, a pedal or also a setting of an electronic control unit, the pressure medium flows via the line 9 and the valve unit 11 to a line 13 and from there into a space 14. The piston 3 actuates the clutch 2 with the force from the differential pressure which acts upon the first piston area 4 and upon the second piston area 5 and actuates the clutch 2 in closing direction. If the pressure acting upon the first piston area 4 changes, the pressure in the line 9 and a line 15 changes whereby the valve unit 9, likewise, changes the

pressure in the line 13 and the differential pressure acting upon the piston 3 remains the same. The clutch 2 is thus actuated with an unchanged closing force.

[023] Fig. 2:

The mode of operation of the hydrodynamic torque converter corresponds to the mode of operation such as disclosed in Fig. 1 and can be understood from the description of Fig. 1.

[024] The hydrodynamic torque converter of Fig. 2 differs from the representation of Fig. 1 in the supply of the pressure medium to the valve unit 11. The valve unit 11 is supplied with pressure medium via a line 16 which is connected with a pressure medium source of a hydraulic pump such as from a rear-mounted powershift transmission. The space 14 is accordingly loaded with pressure medium from the hydraulic pump (not shown) of the transmission. The valve unit 11 is adjusted in a manner analogous to Fig. 1 via the pressure medium, which reaches the valve unit 11 via the line 15.

[025] Fig. 3:

The mode of operation of the hydrodynamic torque converter of Fig. 3 corresponds to the mode of operation of the hydrodynamic torque converter of Figs. 1 and 2.

[026] Unlike the design described in Figs. 1 and 2, the torque converter in Fig. 3 contains one pressure sensor 17 which determines the pressure acting upon the first piston area 4 and supplies it to an electronic control unit 18. The electronic control unit issues a signal to a proportional valve 19 and controls it according to a single rotational speed sensor 20 and nominal value settings 21 and correction factors 22. The proportional valve supplies the space 14 with pressure medium and pressurizes the second piston area 5 in order to apply to the clutch 2 a defined force via the piston 3.

[027] Fig. 4:

The converter housing 1 is connected with a prime mover (not shown) and driven. The primary clutch 2 connects the housing 1 with the pump impeller 6. The turbine impeller 7 can be connected, via a converter bridge clutch 23, with the housing 1. Upon the first piston area 4 acts the variable pressure within the

housing which depends on the operational parameters and the operational state of the converter. The first piston area 4 and the space 10 are connected via the line 9 with a valve or control unit. The pressure of the space 10 can be detected via the line 9. While pressure medium is passed into the space 14, via the line 13, hydraulic pressure acts upon the second piston area 5. The resulting differential pressure from the pressure upon the first piston area 4 and the second piston area 5 actuates the piston 3. In order to supply the clutch 2 in the open state with lubricant, there is located in the piston 3 at least one aperture 24 through which lubricant can be passed through the discs of the clutch 2. It is possible to seal the space 14 by sealing elements 25. The outer discs of the clutch 2 are non-rotatably connected with the pump impeller 6, the inner discs of the clutch 2 being non-rotatably connected with the housing 1.

[028] Fig. 5:

The construction of the hydrodynamic torque converter corresponds to the hydrodynamic torque converter of Fig. 4, the inner rotating discs being non-rotatably connected with the pump impeller 6 and the outer rotating discs of the clutch 2 non-rotatably connected with the housing 1. It is hereby possible to enlarge the area of the piston 3.

Reference numerals

1 converter housing
2 primary clutch
3 piston
4 first piston area
5 second piston area
6 pump impeller
7 turbine impeller
8 pressure medium supply line
9 line
10 space
11 valve unit
12 nominal value setting
13 line
14 space
15 line
16 line
17 pressure sensor
18 electronic control unit
19 proportional valve
20 rotational speed sensor
21 nominal value setting
22 correction factor
23 converter bridge clutch
24 aperture
25 sealing elements